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(54) **Method and apparatus for the decomposition of hazardous materials.**

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FR-A-2 075 745
FR-A-2 280 285
FR-A-2 298 249
US-A-3 812 620
US-A-3 841 239
US-A-4 050 991

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Description

Background of the invention

The present invention relates generally to a method and apparatus for the decomposition of hazardous materials, such as polychlorobiphenyls (PCBs) and the like, and, more particularly, to such a method and apparatus for the pyrolysis of PCBs and other such hazardous materials utilizing a D.C. arc in a sealed electric arc furnace.

Description of the prior art

Polychlorobiphenyl materials (PCBs) have been used extensively in the past in electrical equipment such as transformers and capacitors, due in a large part to their flame retardant characteristic, high temperature stability, inertness to biodegradation and excellent dielectric properties. Other uses in mining equipment, hydraulic systems and heat transfer systems were prompted by these same properties.

In the nineteen sixties it was discovered that PCBs were highly toxic and the environmental impact of PCB contamination received a great deal of coverage in the public press. The fact that PCBs were found to be carcinogenic in mice and are extremely stable has resulted in the enactment of legislation severely restricting the manufacturing, processing and sale of PCBs. The storage and disposal of existing PCBs and materials containing PCBs has also been the subject of legislation, as well as regulation by governmental agencies, such as the Environmental Protection Agency. The exceptional chemical stability which makes PCBs useful as a dielectric fluid and heat transfer agent alsp makes it extremely difficult to destroy.

Four basic techniques have been previously developed for PCB disposal: landfill; chemical destruction; biological destruction; and incineration/pyrolysis.

The simplest and lowest cost technique used for disposal of PCBs has been by landfill. However, at the present time there is only a relatively small number of landfill sites which have obtained the requisite permits from the Environmental Protection Agency and other government agencies for receiving and disposing of PCBs. In the present era of increasing public awareness and with the existing regulatory structure, it is unlikely that a significant number of new landfill sites will be approved for disposal of PCBs. In addition, the existing governmental regulations only permit the disposal of solid materials contaminated by PCBs at landfill sites (liquid PCBs must be incinerated), thereby necessitating the prior draining, flushing and storage of all liquid PCBs. Thus, it is clear that the disposal of PCBs utilizing landfill sites is not a viable final solution to the PCB disposal problem.

Various chemical treatment processes have reportedly been successfully used for the destruction of small quantities of PCBs in the laboratory. One such technique involves the treatment of PCBs with alkaline 2-propanol solution followed by exposing the resulting material to ultraviolet light for a predetermined period of time. Another such chemical treatment technique involves the stepwise removal of electrons from the aromatic ring system of the PCBs, followed by hydrolysis, solvolysis, oxidative coupling and dimerization utilizing high anodic potentials in acetonitrile.

While the above-described chemical treatment process, as well as other chemical treatment processes, have achieved some success in the decomposition of PCBs, the techniques have only been employed in connection with very small quantities of PCBs. These chemical treatment processes would be cumbersome and extremely expensive to employ in connection with the decomposition of large quantities of PCBs. In addition, some of the chemical treatment processes have resulted in the generation of hazardous by-products, which require additional special handling and destruction.

Although PCBs are generally thought to be extremely resistant to biological or enzyme attack, recent studies have shown that some PCBs are degradable by certain strains of bacteria and soil fungus. One such technique involves the use of acromasacter (two species) pseudomonas sp, acinetrobacter sp strain y42+33, and acinetobacter sp strain P6 to oxidatively degrade PCBs to chlorobenzoic acids. A second technique as described in U.S. Patent No. 3,779,866 employs strains of caldosporium cladosporicides, candidelipolytice, nocardia globerola, nocardia rubra and/or saccharomyces cerevisiae to totally destroy PCBs.

Again, while the above-described and other biological techniques have achieved some success in the destruction of PCBs in limited quantities, none of these biological techniques have offered a solution to the disposal of large quantities of PCBs in an environmentally sound manner at a reasonable cost.

In regard to incineration of PCBs, it has been found that PCBs have high thermal stability and generally require combustion temperatures on the order of 1600°C for total destruction. Although numerous prior art attempts have been made to develop a method or system for the incineration of PCBs utilizing different variations of conventional combustion techniques, the prior art methods and processes for the most part have been unsuccessful primarily due to the extreme difficulty involved in maintaining the required 1600°C temperature. The failure to maintain the requisite temperature generally results in an incomplete destruction of the PCBs and may result in the generation of even more toxic by-product materials, such as hexachlorobenzene or polychlorinated dibenzofurans. In addition, the prior art incineration/pyrolysis methods were primarily used for the destruction of liquid PCBs due to difficulties in employing such methods in connection with solids. Furthermore, the prior art techniques resulted in the generation of large volumes of gas which had to be collected and scrubbed to remove various impurities therefrom.

The present invention was developed to overcome various problems associated with a number

of prior art destruction processes. More specifically, the present invention comprises a method and apparatus for the destruction of PCBs and other hazardous materials utilizing a totally sealed system, which includes a high current DC arc for maintaining a temperature considerably in excess of 1600°C and for providing bond-breaking ultraviolet and other radiation. The use of the DC arc assures that the original PCBs are decomposed into relatively harmless gaseous components and that no dangerous intermediate chemicals remain in the exhaust gas. The system of the present invention is capable of effective decomposition of both solid and liquid PCBs and, due to the lack of oxygen or other atmospheric gases present in the sealed system, the need for excessive containment and scrubbing equipment for the exhaust gases is effectively reduced.

US—A—3 812 620 discloses a method and apparatus for the innocuous disposal of heterogeneous solid waste from residential and other sources but it makes no mention of PCBs. It provides a pyrolytic furnace having a chamber with inlets for solid waste and a sump for collection of molten glass and metal and an elongated electrode having an arcing tip in juxtaposition to the surface of a molten pool in the sump and movable towards or away from the surface of the pool. An exhaust passage for gases is provided having its inlet end near the arc.

FR—A—2 075 745 discloses a fluid-cooled electrode having a tip forming an arcing surface from which an arc can be developed. A permanent magnet or a pair of permanent magnets are disposed in such a relationship to the tip that the magnetic field generated exerts a force on the arc which causes it to move substantially continuously around the arcing surface. It makes no mention of PCBs or the decomposition of hazardous material.

Summary of the invention

Briefly stated, the presently claimed invention provides a method and apparatus for the decomposition of hazardous material, especially PCBs, utilizing an electrical direct current (DC) arc. A gas-tight chamber is provided to receive the hazardous material, the chamber including a sump which contains a molten bath. Inlet means are provided for introducing the hazardous material into the chamber and the molten bath for initial decomposition thereof into a product within the molten bath and a gaseous product which remains within the chamber. Electrode means are provided for maintaining a DC arc within the chamber, the arc having a current level sufficient to promote the decomposition of the hazardous material. The electrode means includes an elongated electrode having a first end maintained at a predetermined distance above the surface of the molten bath, the arc from the electrode being maintained to extend from the first end of the electrode across the predetermined distance to the molten bath. Means are provided for moving the arc around the surface of the first end of the electrode at a predetermined rate, this means including a first tubular ferrous member surrounding the electrode adjacent the first end thereof, whereby the arc current interacts with the first ferrous member to generate a magnetic field having flux lines extending generally perpendicular to the arc. An exhaust means is provided within the chamber proximate to the arc for the removal of gases from the chamber. Gases liberated into the chamber are passed in the proximity of the arc for undergoing decomposition prior to their removal through the exhaust means.

The rate of movement of the arc around the surface of the first end of the electrode may be controlled by the intensity and orientation of the magnetic field.

Brief description of the drawings

The foregoing summary, as well as the following detailed description, will be better understood when read in conjunction with the appended drawings, in which:

Fig. 1 is a schematic elevational view, partially in section, of an apparatus for the decomposition of hazardous material which is in accordance with the presently claimed invention except for the means for moving the arc around the surface of the first end of the electrode;

Fig. 2 is a schematic elevational view, partially in section, of an alternate embodiment of apparatus which is in accordance with the presently claimed invention except for the means for moving the arc around the surface of the first end of the electrode;

Fig. 3 is a fragmentary schematic sectional view showing a variation of a portion of the apparatus of Fig. 2;

Fig. 4 is a fragmentary schematic sectional view showing a different variation of the apparatus of Fig. 2 in which the means for moving the arc around the surface of the first end of the electrode is in accordance with the presently claimed invention; and

Fig. 5 is in a schematic view of a pressure relief system employed in connection with the apparatus of Figs. 1 or 2.

Description of the illustrated embodiments

Referring to Fig. 1, there is shown a schematic view of an apparatus or pyrolytic furnace indicated generally as 10, for the decomposition of liquid, solid or gaseous hazardous materials or any combination thereof, such as polychlorobiphenyls (PCBs), PCB contaminated liquids and solids and the like, into innocuous gases by pyrolysis employing a D.C. arc. It has been found that by subjecting PCBs and PCB contaminated liquids and solids to a two-step process in which they are initially exposed to a high temperature (such as in a molten bath) to promote initial decomposition into gaseous product and then exposing the gaseous product to a high current, high temperature D.C. arc, the resulting gaseous product produced comprises CO, CO_2, H_2, CH_4 and HCl.

The furnace 10 comprises, in this embodiment, a generally cylindrical housing 12 having an outer containment shell 14, which may be comprised of

steel or any other similar electrically conductive structural material, and an inner refractory lining 16, which may be comprised of any suitable known electrically conductive furnace lining material, for example, graphite. Because of the high temperatures and pressures involved in the decomposition process conducted within the furnace 10, the outer shell 14 and/or the inner lining 16 must be capable of withstanding an interior pressure of about 500 pKa (5 atmospheres) and may be cooled in any conventional manner, for example, by circulating cooling fluid (such as water) through fluid passages (not shown) which may be embedded within or adjacent to the outer shell 14 and/or the inner lining 16.

Due to the hazardous nature of the PCBs and other materials which are to be decomposed within the furnace 10, it is important the furnace 10 be carefully constructed to maintain a completely gas-tight chamber 18 within which the decomposition takes place. Suitable seals (not shown) are employed where required to maintain the chamber 18 in a gas-tight condition. In this manner, leakage of unreacted or partially decomposed toxic gases into the atmosphere can be avoided. In addition, in the gas-tight chamber, the presence of oxygen in the furnace 10 can be avoided to thereby provide a reducing environment which permits the use of unconventional lining material (such as graphite which would quickly deteriorate from burning in the presence of oxygen) for the furnace 10.

The lower portion of the furnace 10 forms an annular sump 20 within the chamber 18. The sump 20 has maintained therein a molten bath 22 comprised of metals, salts or any other suitable material which, in its molten state, is a good electrical conductor. The molten bath 22 serves to promote the initial decomposition or volitization of the PCBs and other hazardous materials, which may be introduced into the furnace 10, into a gaseous product which is liberated into the chamber 18 above the molten bath 22. In addition, the molten bath 22 serves to melt or decompose any other organic or inorganic materials which may be introduced into the furnace and remain in the molten bath. Such organic or inorganic materials may include, for example, the metal, plastic or cellulose packaging materials which were employed to contain the PCBs. It is considered necessary to destroy such container materials since, due to their prior contact with the PCBs, they are also considered to be hazardous.

As will hereinafter be described in more detail, the temperature of the molten bath 22 is maintained at a level commensurate with the volitization temperature of the particular hazardous material being decomposed. For example, when PCBs are being decomposed, the temperature level of the molten bath may be on the order of 1500°C, which is lower than the temperature for complete destruction of PCBs in the prior art, but lower temperatures are possible in the present system due to the use of the arc which significantly aids the destruction process.

The furnace 10 includes inlet means, shown generally as 24, for charging or introducing the hazardous material from the outside of the housing 12 into the chamber 18. The inlet means 24 comprises a plurality of individual charging ports positioned at various locations around the circumference of the housing 12. By positioning the charging ports around the circumference of the housing 12 the PCBs or other hazardous material may be immersed into different areas of the molten bath 22 (perhaps sequentially) to thereby prevent excessive localized cooling of the molten bath 22 which may occur if only a single charging port is employed. The charging ports must be capable of introducing PCBs or other hazardous material into the chamber 18 while maintaining a generally gas-tight system. In this manner, the furnace 10 has the capability of operating batch (one charge of hazardous material at a time) or operating continuously (continuous addition of hazardous material).

In the present embodiment, two different types of charging ports 26 and 28 are shown and will hereinafter be described in some detail. Furnace 10 may include one or more of each type of the charging ports 26 and 28 or may include one type of charging port or ports. Charging ports 26 and 28, which each comprise a two stage air-lock arrangement, are but two examples of the types of charging ports which may be employed for introducing hazardous material into the chamber 18. Therefore, it should be appreciated that the present invention is not limited to the specific type or combination of charging ports disclosed but could employ any other suitable type or combination of inlet means which allows for introduction of hazardous material into the furnace 10 while effectively maintaining the chamber 18 in a gas-tight condition to prevent the escape of any toxic or otherwise hazardous gas.

Charging port 26 is particularly suited for introducing, for example, capacitors designated 29 into the furnace 10. Capacitors 29 of the type shown may comprise ceramic, cellulose plastic metal and some form of generally sealed metallic outer container which enclose (sometimes under pressure) liquid PCBs as a dielectric element. Both the PCBs within the container and the container itself must be disposed of as hazardous materials. The charging port 26 comprises a sealed (gas-tight) generally tubular passage 30 having an entry port 32 on a first or outer end and an exit port 34 on the second or inner end. The sealed passage 30 further includes a closable partition means 36 positioned approximately halfway between the entry port 32 and the exit port 34 to divide the sealed passage into a first outer compartment 38 adjacent to the entry port 32 and a second inner compartment 40 adjacent to the exit port 34. Each of the ports 32 and 34 and partition 36 are adapted to open and close independently of each other and to provide tight seals when closed, so that the charging port 26 has the capability of continuously charging or introducing material into the furnace 10 while continuing to

maintain the gas-tight condition of the chamber 18.

In the operation of the inlet device 26, the ports 32 and 34 and partition 36 are initially closed as shown. The entry port 32 is then opened and capacitor 29, or other solid or liquid hazardous material to be decomposed or destroyed, is admitted or inserted into the first compartment 38 as shown. The entry port 32 is then closed and the first compartment 38 is evacuated (employing any known suitable means) to prevent the introduction of oxygen into the chamber 18. Thereafter, the partition 36 is opened and the capacitor 29 is passed from the first compartment 38 into the second compartment 40. In the embodiment shown on Fig. 1, the tubular passage 30 slopes slightly downwardly so that the capacitor 29 may simply slide or roll downwardly from the first compartment 38 through the partition 36 to the second compartment 40. Alternatively, any other suitable means could be employed for moving the capacitor 29 from the first compartment 38 to the second compartment 40, such as a push rod (not shown) or a conveyor belt (not shown).

Once the capacitor 29 is positioned within the second compartment 40, the partition 36 is again closed and the first compartment 38 is evacuated to prevent the escape (to the atmosphere) of any toxic gas when the entry port 32 is opened again. The exit port 34 is then opened and the capacitor 29 passes from the second compartment 40 along the downwardly sloping passage 30 and into the molten bath 22. As previously mentioned, any other suitable means may be employed for moving the capacitor 29 from the second compartment 40 into the molten bath 22.

While in some cases it is desirable to have entire capacitors inserted directly into the molten bath 22 as described above, in other cases this is not an acceptable procedure. Because of the size and construction of some capacitors, and particularly large pressure sealed capacitors, the immersion of the entire capacitor directly into the molten bath 22 would result in a build-up in pressure within the capacitor and eventually a violent or uncontrolled explostion which may result in potential damage to the furnace. In order to alleviate the potential explosion hazard, the second compartment 40 may include suitable means 42, for example the multi-pronged "iron maiden" shown in Fig. 1, for puncturing and/or crushing the capacitor 29 in order to prevent the formation of excessive pressure. In addition, by puncturing or crushing the capacitor 29 in this manner, the liquid PCBs within the capacitor 29 are permitted to drain from the capacitor container.

The lower end of the second compartment 40 includes an opening into a conduit means or drain pipe 44 which communicates with the interior of the chamber 18 as shown. The drain pipe 44 receives liquid PCBs from the punctured or crushed capacitor 29 and allows liquid PCBs to flow into the molten bath 22. The liquid PCBs may be preheated utilizing waste heat from the furnace 10 (not shown) prior to their entering the molten bath 22. A suitable valve means 46, which may be provided by any suitable known control valve, may be installed within the drain pipe 44 in order to restrict and control the flow of liquid PCBs into the molten bath 22. In addition, the liquid PCBs may be pressurized, atomized and sprayed (not shown) against the surface of the molten bath 22 to provide more intimate contact between the PCBs and the molten bath and to avoid localized cooling of the bath.

As discussed briefly above, each of the compartments 38 and 40 of the charging port 26 also includes a suitable evacuation system (not shown) for removing any gases which may enter either compartment from the chamber 18 or from the atmosphere. The evacuated gas from the compartments 38 and 40 is preferably recylced back into the chamber 18 by any suitable means (not shown) to provide for the processing of any hazardous gas which may be present. Such an evacuation system may be of any suitable known type and need not be described in detail for a complete understanding of the present invention.

Charging port 28 is similar to charging port 26, in that, it comprises a generally tubular sealed (gas-tight) passage 48 having an entry port 50, an exit port 52 and a partition means 54 to divide the passage 48 into a first outer compartment 56 and a second inner compartment 58. Both of the compartments 56 and 58 include an evacuation system (not shown) for the purposes described in connection with charging port 26. However, unlike charging port 26, the second compartment 58 of charging port 28 includes a conventional motor driven screw conveyor or auger 60. The screw conveyor 60 transports the PCBs and the PCB containers received within compartment 58 to the exit port 52 and for the reasons as stated above, punctures or crushes the capacitors or containers.

The second compartment 58 of the inlet device 28 also includes a conduit means or drain pipe 62 for conveying the liquid PCBs from punctured capacitors (not shown) within the second compartment 58 to the molten bath 22. However, unlike the previously discussed arrangement of drain pipe 44, drain pipe 62 empties directly into the molten bath 22 below the surface thereof. A suitable pump 64 is employed to provide enough pressure to "bubble" the liquid PCBs directly into the molten bath 22 as well as to control the flow rate of liquid PCBs into the bath.

As discussed above, the immersion of the PCBs into the high temperature molten bath 22 results in the decomposition of the PCBs into gases which remain within the chamber 18 above the molten bath 22. As the gases come into contact with the high temperature upper surface of the molten bath 22, the chemical bonds are further broken. By controlling the quantity of PCBs which are immersed into the molten bath 22 (i.e., through the use of valve 46 and pump 64), the quantity of the gases subsequently released into the chamber 18 and thus, the gas pressure within

the chamber 18, may be controlled. The housing 12 should be strong enough to withstand a gas pressure of about 500 pKa (5 atmospheres) within the chamber 18 with no uncontrolled leakage of gas to the atmosphere.

The furnace 10 also includes electrode means, generally designated 66, for maintaining a direct current (DC) electric arc within the chamber 18. The electrode means 66 comprises in part an elongated tubular electrode 68 movably mounted to the furnace cover 70. The electrode 68 is moved vertically with respect to the molten bath 22 for the purpose of establishing and maintaining the desired electrical arc (shown generally as 72) extending from the arcing tip 82 to the molten bath 22. Any suitable means may be employed for the vertical movement of the electrode 68. For example, a rack 74 may be fixed to the electrode and a suitable pair of motor-driven pinions 76 may be employed to engage the electrode rack 74 for movement thereof in either vertical direction.

The furnace 10 also includes exhaust means, generally designated 78, for the removal of gases from the gas-tight chamber 18. In the present embodiment, the exhaust means 78 comprises the hollow interior of the tubular electrode 68 which communicates with a suitable exhaust conduit 80 extending through the furnace cover 70 to atmosphere. However, it should be appreciated that any other suitable exhaust means (other than the hollow interior of the tubular electrode 68) could be employed for the removal of gases from the chamber 18. The only requirement for the exhaust means 78 is that its entrance be located proximate to the arcing tip 82 of the electrode 68, so that all of the gases within the chamber 18 must pass near or through the arc 72 before being exhausted from the furnace 10.

The exhaust gas removed from the furnace 10 may be received and stored in suitable containers (not shown) for testing and analysis. If the analyzed gas is found to be clean enough to comply with existing regulations or standards, it may be exhausted directly to the atmosphere. If the analyzed gas is found to be of unacceptable quality, it may be further processed by a suitable device such as a bubble tank (not shown) or a scrubber (not shown). An exit gas afterburner (not shown) may also be employed. In the event that the exhaust gas from the furnace still contains toxic or other hazardous material, the gas may be recycled by any suitable means (not shown) back into the chamber 18 for further processing relative to the electric arc. Suitable heat exchange means (not shown) may be provided to lower the temperature of the exhaust gases from the furnace and to reclaim or recycle the recovered thermal energy.

In order to provide a substantially continuous DC arc within the chamber 18 between the arcing tip 82 of the electrode 68 and the molten bath 22, the outer shell 14 of the furnace is connected to ground (not shown) and the electrode is connected to a suitable low voltage, solid state DC current supply (not shown). Preferably, the DC current supply is so poled that the electrode 68 is negative with respect to the outer shell 14. The conductive inner lining 16 and the conductive molten bath 22 are also maintained at ground potential. Thus, the electrode 68 constitutes the negative terminal and the molten bath 22 constitutes the positive terminal of a DC load circuit. As shown, the two terminals (the electrode 68 and the molten bath 22) are spaced apart in operation to provide between them an arc gap of a predetermined distance in which the arc 72 exists when the circuit is energized. A current regulator (not shown) may be provided to maintain a substantially constant predetermined arc level as required for the desired decomposition of the hazardous material being processed. Arc voltage sensing equipment (not shown) may also be employed to compare the arc voltage with a preset reference for comparison and arc length control. A DC choke coil (not shown) may also be connected in series with the DC arc current path in order to prevent arc extinction due to any sudden rise in arc voltage, any sudden cooling of the arc due to endothermic chemical reactions, or to transient gas pressures which occur during PCB decomposition.

The arc 72 provides the primary heat to initially melt and thereafter maintain the material within the sump in the molten state. The arc 72 also serves as a source of radiation, for example, ultraviolet radiation, which assists in breaking the bonds of the PCBs. In addition, the extreme high temperature of the arc (10,000°C or higher) assures that the gases and any previously non-decomposed material passing through or near the arc toward the exhaust means 78 are completely decomposed into the above-described generally innocuous gaseous elements.

In order to further insure that the gases from the chamber 18 obtain maximum exposure to the arc for complete decomposition, the furnace 10 also includes means, generally designated 84, for rapidly and uniformly moving the arc 72 in a predetermined path around the surface of the arcing tip 82 of the electrode 68. The rapid rotation of the arc 72 around the arcing tip 82 also provides a more uniform distribution of heat to the molten bath 22 and processing in the chamber 18 which tends to preserve the inner lining 16. The rotating arc also puts pressure on the molten bath material where the arc hits the molten bath 22, this together with the high temperature of the arc causes the material to boil and form an indentation in molten bath material. The rotation of the arc around the arcing tip 82 may be so fast that the indentation may not be refilled, and high temperature boiling material is spewed out in the vicinity of the indentation. The gases passing proximate the arc are contacted by the heat and the super heated bath material to aid in decomposition.

In the embodiment of Fig. 1, the means for moving the arc around the surface of the arcing tip 82 of the tubular electrode 68 is not in accordance with the presently claimed invention

but comprises magnetic means in the form of an annular electromagnetic coil 86 positioned within the housing 12 beneath the arcing tip 82. The electromagnetic coil 86 is connected to a suitable DC voltage source (not shown) to generate a magnetic field having flux lines (not shown) extending generally perpendicular to the arc 72. In this manner, well-known magnetohydrodynamics principles are employed to move the arc 72 around the surface of the arcing tip 82. The rate of movement of the arc around the arcing tip 82 is controlled by controlling the location of the electromagnetic coil 86 and the intensity and orientation of the magnetic field generated by the coil 86. The magnetic field also serves to stir the molten bath 22 to provide more complete mixing of the molten bath material and the hazardous materials which are being decomposed. In this manner, the upper surface of the molten bath 22 is kept in condition to receive and react with newly introduced hazardous material.

As hazardous material and the various inorganic (metallic) containers associated therewith are added to the furnace 10, the level of the molten bath 22 tends to rise. In order to maintain the molten bath 22 at a predetermined depth commensurate with the size of the chamber, the length of the arc and other such factors, it is necessary to provide a means for removing some of the material from the molten bath 22 while still continuing the decomposition of the hazardous material. In the present embodiment, the means for maintaining the molten bath at the desired predetermined depth comprises a generally cylindrical container 88 positioned beneath the center of the furnace housing 12. An annular weir 90 is provided to establish the predetermined depth of the molten bath. Whenever the depth of the molten bath exceeds the height of the weir 90, molten material flows over the weir 90, through a conduit means or drain pipe 92 and into the cylindrical container 88. The conduit means 92 and the cylindrical container 88 are provided with suitable sealing means (not shown) in order to maintain the chamber 18 in the gas-tight condition.

The cylindrical container 88 is removably attached to the furnace housing 12. In this manner, material flowing from the molten bath 22 over the weir 90 may be collected in the cylindrical container 88 until the cylindrical container is filled. The cylindrical container may then be removed from the furnace housing 12 and the material collected therein may be suitably emptied and/or disposed of in a conventional manner. In order to ensure that the chamber 18 remains gas-tight during the period of time when the cylindrical container 88 is removed for emptying, a suitable sealing apparatus 94 is provided to close off the conduit means 92. A suitable evacuation system (not shown) may also be provided to remove any gases which may have accumulated within the cylindrical container 88. The gases removed from the cylindrical container 88 are recycled back into the chamber 18. By first sealing off the conduit means 92 with the sealing apparatus 94 and then employing the evacuation system to remove gases accumulated in the cylindrical container 88, the container 88 may be removed for emptying without affecting the continued operation of the furnace 10. Once the empty container is replaced, the sealing apparatus 94 is again opened and molten material may again flow through the conduit means 92 for collection in the container 88.

Alternatively, excess material may be removed from the molten bath 22 by means of a standard tap or drain (shown in phantom as 96). However, in order to utilize such a tap or drain 96, it is first preferable to halt the normal operation of the furnace 10. Material removed through the tap 94 may be suitably disposed of in any conventional manner.

As a variation of the above-described embodiment, the gases from the chamber 18 may be exhausted through the conduit means 92, into the cylindrical container 88 and out of an alternate exhaust conduit (shown in phantom as 81). In this manner, the gases may react with the material within the container 88 for further processing.

Referring now to Fig. 2, there is shown an apparatus or furnace 110 for the decomposition of hazardous material which is substantially the same as the furnace 10 of Fig. 1. In connection with the description of Fig. 2, the same numbers will be used for the same components but with the addition of 100 thereto. Viewing Fig. 2, it can be seen that the furnace 110 comprises a generally cylindrical housing 112 which defines a gas-tight, generally cylindrical chamber 118. Within the chamber 118 is a molten bath 122 of metal, salt or any other suitable conductive material. A generally tubular electrode 168 is similarly movably attached to the furnace cover 170. As in the furnace shown in Fig. 1, the center of the tubular electrode 168 comprises an exhaust means 178 which further includes an exhaust conduit 180 to permit the removal of gases from the chamber 118 to the outside of the furnace 110. The furnace 110 further includes suitable inlet means (not shown in Fig. 2) for introducing hazardous material into the chamber 118 in the same manner as was shown and described in connection with Fig. 1.

The primary difference between the furnace 10 of Fig. 1 and the furnace 110 of Fig. 2 is in the manner in which the excess material is removed from the molten bath. As shown on Fig. 2, a generally cylindrical container 188 is provided adjacent to one side of the furnace housing 112. The adjacent side wall of the furnace housing 112 includes an opening which forms a weir 190 to establish the depth level of the material within the molten bath 122. Any material rising above the level of the weir 190 flows through a conduit means 192 and into the container 188. The container 188 is removable from the conduit means 192 and both the container 188 and the conduit means 192 are provided with suitable sealing means (not shown) to preserve the gas-tight

integrity of the chamber 118. A suitable sealing apparatus 194 is provided to close off and seal the conduit means 192 when the container 188 has been removed for emptying. A suitable evacuation system 198 comprising a suitable pump 200 and a corresponding check valve 202 is provided to evacuate any gases which may accumulate in the container 188 prior to emptying the container. As shown, the gases removed from the container 188 are recycled back into the chamber 118 for further processing.

A further difference between the furnace 10 of Fig. 1 and the furnace 110 of Fig. 2 is in the location of the annular electromagnetic coil 186 which is employed to cause the rotation of the arc 172 around the arcing tip 182 of the tubular electrode 168 and which is likewise not in accordance with the presently claimed invention. As shown, the electromagnetic coil 186 is located on the outside of the housing 112 beneath the electrode 168. In order to insure that the housing 112 does not interfere with the magnetic field generated by the external electromagnetic coil 186, the lower portion of the housing is comprised of non-magnetic material as shown. As in the embodiment of Fig. 1, the flux lines from the magnetic field are perpendicular to the arc 172, thereby causing the arc to rotate around the surface of the arcing tip 182.

Fig. 3 shows a slight variation of the furnace of Fig. 2, wherein the same numbers are used as appear in Fig. 2 but with the addition of primes thereto. In Fig. 3, the conduit means 192' for removing material from the molten bath 122' is positioned beneath the surface of the molten bath. The conduit 192' further includes a standard plumber's P-trap arrangement 104' to effectively prevent gases contained within the chamber 118' from entering the container 188'. A sealing apparatus 194' is also provided to faciliate the emptying of the container 188' without any interruption of furnace operation.

Fig. 4 shows a different variation of the furnace of Fig. 2 in which a different means is provided for moving the arc 472 around the arcing electrode tip 482, this means being in accordance with the presently claimed invention. Referring to Fig. 4, the same numbers are used as in Fig. 1 but with the addition of 400 thereto. In Fig. 4, instead of employing an electromagnetic coil, as was done in connection with the embodiment of Fig. 2, a first ferrous member 406 which is generally cylindrical in the embodiment illustrated but need not be so shaped) is positioned within the hollow interior of the tubular electrode 468 adjacent to the arcing tip 482. Similarly, a tubular ferrous member 407 surrounds the tubular electrode 468 adjacent to the arcing tip 482. Both of the ferrous members 406 and 407 may be cooled employing a suitable known cooling system (not shown) which uses a heat transfer fluid such as water (not shown). The ferrous members 406 and 407 interact with the arc current to generate a magnetic field having flux lines (not shown) which extend generally perpendicular to the arc 472. In this manner, the arc is made to r tate around the surface of the arcing tip 482 in the same manner as was discussed in detail in relation to the apparatus of Fig. 1.

Referring now to Fig. 5, there is shown a schematic representation of a pressure relief system generally designated 500 which may be employed in connection with furnace 10 of the type described in Fig. 1 or any of the above-described alternative furnace embodiments. The pressure relief system comprises a sealed (gas-tight) container or surge tank 502 located proximate to the furnace 10. A suitable first conduit means 504 extends between the furnace 10 and the sealed container 502 and provides communication between the interiors thereof. A pressure relief valve 506 is positioned within the first conduit means 504 to control and effectuate relief of the pressure within the furnace 10, if necessary. As described above, the furnace 10 should be constructed to withstand an internal gas pressure of about 500 pKa (5 atmospheres) without leaking any gas therefrom. The pressure relief valve 506 should be designated to relieve the furnace pressure at a preset pressure point slightly less than the 500 pKa (5 atmosphere) level.

Once the preset pressure point of the pressure relief valve 506 has been exceeded the excess gas from the furnace 10 flows into the container 502 thereby lowering the pressure within the furnace. A second conduit means 508 and a suitable pump 510 are provided to return gas from the sealed container 502 to the furnace 10 for further processing when the pressure within the furnace has decreased to an acceptable level.

From the foregoing description and the accompanying figures, it can be seen that the preesnt invention provides a method and apparatus for the decomposition of PCBs and other hazardous material which is efficient, relatively easy to control and is very effective in operation.

Claims

1. An apparatus for the decomposition of hazardous material utilizing a DC arc, comprising:

a gas-tight chamber including a sump which contains a molten bath;

inlet means for introducing the hazardous material into the chamber and the molten bath for initial decomposition of the hazardous material into a product within the molten bath and a gaseous product within the chamber;

electrode means for maintaining a DC arc within the chamber, the arc having a current level sufficient to promote the decomposition of the hazardous material, wherein the electrode means includes an elongated electrode having a first end maintained at a predetermined distance above the surface of the molten bath, the arc from the electrode being maintained to extend from the first end of the electrode across the predetermined distance to the molten bath;

means for moving the arc around the surface of the first end of the electrode at a predetermined

rate including a first tubular ferrous member surrounding the electrode adjacent the first end thereof, whereby the arc current interacts with the first ferrous member to generate a magnetic field having flux lines extending generally perpendicular to the arc; and

exhaust means within the chamber proximate to the DC arc for the removal of gases from the chamber, whereby the gaseous product passes in the proximity of the arc for undergoing decomposition prior to removal thereof through the exhaust means.

2. An apparatus as claimed in claim 1 characterised in that said elongated electrode is generally tubular and said means for moving the arc around the surface of the first end of the electrode at a predetermined rate includes a second ferrous member disposed within the hollow interior of the electrode adjacent the first end thereof whereby the arc current interacts with the first and second ferrous members to generate a magnetic field having flux lines extending generally perpendicular to the arc.

3. Apparatus as claimed in claim 1 or 2, characterised in that it includes means for maintaining the molten bath at a predetermined temperature.

4. Apparatus as claimed in any of claims 1 to 3, characterised in that it includes means for maintaining the molten bath at a predetermined depth.

5. Apparatus as claimed in claim 4, characterised in that the means for maintaining the molten bath at a predetermined depth comprises:

a container for receiving material from the molten bath;

conduit means communicating between the molten bath and the container for the passage of molten material from the molten bath to the container; and

means for sealing the conduit means to block the flow of molten material from the molten bath to the container and to maintain the chamber in its gas-tight condition.

6. Apparatus as claimed in claim 5, characterised in that the container is located beneath the chamber and wherein the conduit means extends upwardly a predetermined distance from the bottom of the chamber into the molten bath.

7. Apparatus as claimed in claim 6, characterised in that said conduit means forms a weir in the molten bath and said exhaust means comprises said conduit means.

8. Apparatus as claimed in claim 6 or 7, characterised in that said conduit means extends upwardly a predetermined distance from the bottom of the chamber into the molten bath generally beneath the electrode means.

9. Apparatus as claimed in claim 5, characterised in that the container is positioned beside the chamber and the conduit means extends through a side wall of the chamber.

10. Apparatus as claimed in claim 9, characterised in that the conduit means extends through a side wall of the chamber to provide a weir to establish a depth level for the molten bath so that any material in the molten bath rising above the level of the weir flows through the conduit means to the container.

11. Apparatus as claimed in claim 9 or 10, characterised in that the conduit means includes trap means to prevent gas from the chamber from entering the container.

12. Apparatus as claimed in any of claims 1 to 11, characterised in that the inlet means comprises a multi-sealed passage having a closable entry port for access outside the chamber and a closable exit port providing communication inside the chamber, the passage further including closable partition means between the entry port and the exit port for dividing the passage into a first compartment adjacent the entry port and a second compartment adjacent the exit port, the sealed passage operating such that the hazardous material is introduced into the first compartment with the partition means closed, the hazardous material passing from the first compartment into the second compartment through the partition means with the entry port and the exit port closed, and the hazardous material passing from the second compartment into the chamber through the exit port with the partition means closed.

13. Apparatus as claimed in claim 12, characterised in that it includes means within the second compartment for puncturing containers with hazardous material therein to release hazardous material therefrom.

14. Apparatus as claimed in claims 12 or 13, characterised in that it includes conduit means communicating between the second compartment and the chamber for removing liquid hazardous material from the second compartment and introducing the liquid hazardous material into the chamber at a controlled rate.

15. Apparatus as claimed in claim 14, characterised in that the conduit means includes valve means for controlling the flow of liquid hazardous material from the second compartment to the chamber.

16. Apparatus as claimed in any of claims 12 to 15, characterised in that it includes screw conveyor means for moving hazardous material from the second compartment into the chamber.

17. Apparatus as claimed in any of claims 1 to 11, characterised in that the inlet means comprises a sealable passage having a closable entry port for access outside the chamber and a closable exit port providing communication inside the chamber, and puncturing means within the passage for puncturing containers with hazardous material therein.

18. Apparatus as claimed in claim 17, characterised in that it includes conduit means communicating between the sealable passage and the chamber for removing liquid hazardous material from the passage and introducing the liquid hazardous material into the chamber.

19. Apparatus as claimed in claim 18, characterised in that the conduit means includes valve means for controlling the flow of liquid hazardous material from the passage into the chamber.

20. Apparatus as claimed in any of claims 17 to 19, characterised in that it comprises screw conveyor means disposed within said passage for moving hazardous material through said passage into the chamber.

21. A method for the decomposition of hazardous material characterised in that it is carried out in apparatus as claimed in any of claims 1 to 20.

22. A method as claimed in claim 21, characterised in that the hazardous material is a polychlorobiphenyl or material containing polychlorobiphenyls.

Patentansprüche

1. Vorrichtung zur Zersetzung von schädlichen Stoffen unter Verwendung eines Gleichstromlichtbogens, umfassend:

eine gasdichte Kammer, einschließlich eines Sumpfes, der ein Schmelzbad enthält;

Einlaßmittel zum Einführen der schädlichen Stoffe in die Kammer und das Schmelzbad zur Erstzersetzung der schädlichen Stoffe in ein Produkt innerhalb des Schmelzbades und ein gasförmiges Produkt innerhalb der Kammer;

Elektrodenmittel zum Aufrechterhalten eines Gleichstromlichtbogens innerhalb der Kammer, wobei der Lichtbogen einen ausreichenden Strompegel besitzt, um die Zersetzung der schädlichen Stoffe zu fördern, worin die Elektrodenmittel eine längliche Elektrode aufweisen, deren erstes Ende in vorbestimmtem Abstand über der Oberfläche des Schmelzbades gehalten wird, wobei der Lichtbogen der Elektrode aufrechterhalten wird, um sich vom ersten Ende der Elektrode über den vorbestimmten Abstand zu dem Schmelzband zu erstrecken;

Mittel zur Bewegung des Lichtbogens über die Oberfläche des ersten Endes der Elektrode bei einer vorbestimmten Geschwindigkeit, einschließlich eines ersten rohrförmigen Eisenteils, das die Elektrode angrenzend an ihr erstes Ende umgibt, wodurch der Lichtbogenstrom mit dem ersten Eisenteil in Wechselwirkung tritt, um ein Magnetfeld zu erzeugen, dessen Feldlinien allgemein senkrecht zu dem Lichtbogen verlaufen; und

Auslaßmittel innerhalb der Kammer nahe dem Gleichstromlichtbogen zum Abführen von Gasen aus der Kammer, wodurch das gasförmige Produkt in der Nähe des Lichtbogens entlangströmt, um Zersetzung durchzumachen, bevor es durch die Auslaßmittel abgeführt wird.

2. Vorrichtung nach Anspruch 1, dadurch gekenzneichnet, daß besagte längliche Elektrode allgemein röhrenförmig ist, und besagte Mittel zur Bewegung des Lichtbogens um die Oberfläche des ersten Endes der Elektrode bei einer vorbestimmten Geschwindigkeit ein zweites Eisenteil enthalten, das innerhalb des hohlen Inneren der Elektrode angrenzend an ihr erstes Ende angeordnet ist, wodurch der Lichtbogenstrom mit den ersten und zweiten Eisenteilen in Wechselwirkung tritt, um ein Magnetfeld zu erzeugen, dessen Feldlinien allgemein senkrecht zu dem Lichtbogen verlaufen.

3. Vorrichtung nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß sie Mittel besitzt, um das Schmelzbad auf einer vorbestimmten Temperatur zu halten.

4. Vorrichtung nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß sie Mittel besitzt, um das Schmelzbad auf einem vorbestimmten Füllstand zu halten.

5. Vorrichtung nach Anspruch 4, dadurch gekennzeichnet, daß die Mittel, um das Schmelzbad auf einem vorbestimmten Füllstand zu halten, umfassen:

einen Behälter zur Aufnahme von Stoffen aus dem Schmelzbad;

Leitungsmittel, die zwischen dem Schmelzbad und dem Behälter eine Verbindung zum Durchfluß von Schmelzgut aus dem Schmelzbad zu dem Behälter herstellen; und

Mittel zum Abdichten der Leitungsmittel, um den Schmelzgutfluß aus dem Schmelzbad zu dem Behälter zu sperren und die Kammer in ihrem gasdichten Zustand zu erhalten.

6. Vorrichtung nach Anspruch 5, dadurch gekennzeichnet, daß der Behälter unterhalb der Kammer angeordnet ist, und worin die Leitungsmittel eine vorbestimmte Strecke von dem Boden der Kammer in das Schmelzbad nach oben verlaufen.

7. Vorrichtung nach Anspruch 6, dadurch gekennzeichnet, daß besagte Leitungsmittel in dem Schmelzbad ein Wehr bilden und besagte Auslaßmittel jene Leitungsmittel umfassen.

8. Vorrichtung nach Anspruch 6 oder 7, dadurch gekennzeichnet, daß diese Leitungsmittel allgemein unterhalb der Elektrodenmittel eine vorbestimmte Strecke von dem Boden der Kammer in das Schmelzbad nach oben verlaufen.

9. Vorrichtung nach Anspruch 5, dadurch gekennzeichnet, daß der Behälter neben der Kammer angeordnet ist, und die Leitungsmittel sich durch eine Seitenwand der Kammer erstrecken.

10. Vorrichtung nach Anspruch 9, dadurch gekennzeichnet, daß die Leitungsmittel sich durch eine Seitenwand der Kammer erstrecken, um ein Wehr zur Festlegung eines Schmelzbadfüllstandes vorzusehen, so daß alle Stoffe in dem Schmelzbad, welche die Wehrhöhe übersteigen, durch die Leitungsmittel zu dem Behälter fließen.

11. Vorrichtung nach Anspruch 9 oder 10, dadurch gekennzeichnet, daß die Leitungsmittel Abfangsmittel enthalten, um zu verhindern, daß Gas aus der Kammer in den Behälter eintreten kann.

12. Vorrichtung nach einem der Ansprüche 1 bis 11, dadurch gekennzeichnet, daß die Einlaßmittel einen mehrfach abgedichteten Durchgang umfassen, der eine absperrbare Eingangsöffnung für Zugang außerhalb der Kammer und eine absperrbare Ausgangsöffnung zur Herstellung einer Verbindung innerhalb der Kammer besitzt, wobei der Durchgang außerdem absperrbare Trennmittel zwischen der Eingangsöffnung und der Ausgangsöffnung aufwesit, um dem Durchgang in eine erste, an die Eingangsöffnung angrenzende Zelle und eine zweite, an die Ausgangsöffnung angren-

zende Zelle aufzuteilen, und der abgedichtete Durchgang solcherart funktioniert, daß die schädlichen Stoffe bei geschlossenen Trennmitteln in die erste Zelle eingeführt werden, die schädlichen Stoffe bei geschlossenen Eingangs- und Ausgangsöffnungen aus der ersten Zelle durch die Trennmittel hindurch in die zweite Zelle geführt werden, und die schädlichen Stoffe bei geschlossenen Trennmitteln aus der zweiten Zelle durch die Ausgangsöffnung hindurch in die Kammer geführt werden.

13. Vorrichtung nach Anspruch 12, dadurch gekennzeichnet, daß sie innerhalb der zweiten Zelle Mittel zum Durchstechen der Behälter mit den darin befindlichen schädlichen Stoffen aufweist, um die schädlichen Stoffe daraus freizusetzen.

14. Vorrichtung nach Anspruch 12 oder 13, dadurch gekennzeichnet, daß sie Leitungsmittel aufweist, welche zwischen der zweiten Zelle und der Kammer einer Verbindung herstellen, um flüssige schädliche Stoffe aus der zweiten Zelle abzuleiten und die flüssigen schädlichen Stoffe bei geregelter Geschwindigkeit in die Kammer einzuführen.

15. Vorrichtung nach Anspruch 14, dadurch gekennzeichnet, daß die Leitungsmittel ein Ventil aufweisen, um die Strömung der flüssigen schädlichen Stoffe aus der zweiten Zelle in die Kammer zu regeln.

16. Vorrichtung nach einem der Ansprüche 12 bis 15, dadurch gekennzeichnet, daß sie eine Förderschnecke aufweist, um schädliche Stoffe aus der zweiten Zelle in die Kammer zu befördern.

17. Vorrichtung nach einem der Ansprüche 1 bis 11, dadurch gekennzeichnet, daß die Einlaßmittel einen abdichtbaren Durchgang umfassen, der eine absperrbare Eingangsöffnung für Zugang außerhalb der Kammer und eine ansperrbare Ausgangsöffnung zur Herstellung einer Verbindung innerhalb der Kammer besitzt, sowie Durchstechmittel innerhalb des Durchgangs zum Durchstechen von Behältern mit darin befindlichen schädlichen Stoffen.

18. Vorrichtung nach Anspruch 17, dadurch gekennzeichnet, daß sie Leitungsmittel aufweist, welche zwischen dem abdichtbaren Durchgang und der Kammer eine Verbindung herstellen, um flüssige schädliche Stoffe aus dem Durchgang abzuleiten und die flüssigen schädlichen Stoffe in die Kammer einzuführen.

19. Vorrichtung nach Anspruch 18, dadurch gekennzeichnet, daß die Leitungsmittel ein Ventil aufweisen, um die Strömung der flüssigen schädlichen Stoffe aus dem Durchgang in die Kammer zu regeln.

20. Vorrichtung nach einem der Ansprüche 17 bis 19, dadurch gekennzeichnet, daß sie eine Förderschnecke aufweist, die innerhalb jenes Durchgangs angeordnet ist, um schädliche Stoffe durch den Durchgang in die Kammer zu befördern.

21. Verfahren zur Zersetzung von schädlichen Stoffen, dadurch gekennzeichnet, daß es in einer Vorrichtung nach einem der Ansprüche 1 bis 20 ausgeführt wird.

22. Verfahren nach Anspruch 21, dadurch gekennzeichnet, daß die schädlichen Stoffe aus Polychlorbiphenyl oder aus Polychlorbiphenyl enthaltenden Stoffen bestehen.

Revendications

1. Appareil pour la décomposition de matières dangereuses utilisant un arc électrique à courant continu, comprenant:

une chambre étanche aux gaz comportant une citerne qui contient un bain fondu;

des moyens d'entrée pour introduire les matières dangereuses dans la chambre et dans le bain fondu en vue de la décomposition initiale des matières dangereuses en un produit se trouvant à l'intérieure du bain fondu et un produit gazeux se trouvant à l'intérieur de la chambre;

des moyens d'électrode pour maintenir un arc électrique à courant continu à l'intérieur de la chambre, l'arc ayant un niveau de courant suffisant pour stimuler la décomposition des matières dangereuses, dans lesquels les moyens d'électrode comprennent une électrode allongée ayant une première extrémité maintenue à une distance prédéterminée au-dessus de la surface du bain fondu, l'arc jaillissant de l'électrode étant entretenu afin de s'étendre depuis la première extrémité de l'électrode sur la distance prédéterminée jusqu'au bain fondu;

des moyens pour déplacer l'arc autour de la surface de la première extrémité de l'électrode avec une vitesse prédéterminée, comprenant un premier élément tubulaire ferreux entourant l'électrode à proximité de la première extrémité de celle-ci, le courant de l'arc réagissant de ce fait avec le premier élément ferreux pour créer un champ magnétique ayant des lignes de flux qui s'étendent dans une direction généralement perpendiculaire à l'arc; et

des moyens d'échappement à l'intérieur de la chambre, à proximité de l'arc électrique à courant continu, pour évacuer les gaz de la chambre, le produit gazeux passant de ce fait à proximité de l'arc pour subir la décomposition avant d'être évacué à travers les moyens d'échappement.

2. Appareil suivant la revendication 1, caractérisé en ce que ladite électrode allongée est généralement tubulaire et en ce que lesdits moyens pour déplacer l'arc autour de la surface de la première extrémité de l'électrode avec une vitesse prédéterminée comprennent un second élément ferreux disposé dans l'intérieur creux de l'électrode à proximité de la première extrémité de celle-ci, le courant de l'arc réagissant de ce fait avec les premier et second éléments ferreux pour créer un champ magnétique ayant des lignes de flux qui s'étendent dans une direction généralement perpendiculaire à l'arc.

3. Appareil suivant la revendication 1 ou 2, caractérisé en ce qu'il comprend des moyens pour maintenir le bain fondu à une température prédéterminée.

4. Appareil suivant l'une ou l'autre des revendications 1 à 3, caractérisé en ce qu'il comporte des moyens pour maintenir le bain fondu à une profondeur prédéterminée.

5. Appareil suivant la revendication 4, caractérisé en ce que les moyens pour maintenir le bain fondu à une profondeur prédéterminée comprennent:

un récipient pour recevoir les matières provenant du bain fondu;

des moyens de conduit communiquant entre le bain fondu et le récipient pour le passage de matières fondues depuis le bain fondu vers le récipient; et

des moyens pour obturer les moyens de conduit pour interrompre l'écoulement de matières fondues depuis le bain fondu vers le récipient et pour maintenir la chambre dans son état étanche aux gaz.

6. Appareil suivant la revendication 5, caractérisé en ce que le récipient est situé sous la chambre et dans lequel les moyens de conduit s'étendent vers le haut sur une distance prédéterminée à partir du fond de la chambre jusque dans le bain fondu.

7. Appareil suivant la revendication 6, caractérisé en ce que lesdits moyens de conduit forment un déversoir dans le bain fondu et en ce que lesdits moyens d'échappement comprennent lesdits moyens de conduit.

8. Appareil suivant la revendication 6 ou 7, caractérisé en ce que lesdits moyens de conduit s'étendent vers le haut sur une distance prédéterminée à partir du fond de la chambre jusque dans le bain fondu généralement sous les moyens d'électrode.

9. Appareil suivant la revendication 5, caractérisé en ce que le récipient est disposé à côté de la chambre et en ce que les moyens de conduit s'étendent à travers une paroi latérale de la chambre.

10. Appareil suivant la revendication 9, caractérisé en ce que les moyens de conduit s'étendent à travers une paroi latérale de la chambre pour constituer un déversoir afin d'établir un niveau de profondeur pour le bain fondu de telle façon que toute matière du bain fondu s'élevant plus haut que le niveau de déversoir s'écoule à travers les moyens de conduit vers le récipient.

11. Appareil suivant la revendication 9 ou 10, caractérisé en ce que les moyens de conduit comprennent des moyens de piège pour empêcher le gaz provenant de la chambre d'entrer dans le récipient.

12. Appareil suivant l'une ou l'autre des revendications 1 à 11, caractérisé en ce que les moyens d'entrée comprennent un passage multi-joints comportant un orifice d'entrée obturable donnant accès à l'extérieur de la chambre et un orifice de sortie obturable assurant une communication vers l'intérieur de la chambre, le passage comportant en outre des moyens de séparation obturables entre l'orifice d'entrée et l'orifice de sortie pour diviser le passage en un premier compartiment voisin de l'orifice d'entrée et un second compartiment voisin de l'orifice de sortie, le passage étanche fonctionnant de telle façon que les matières dangereuses soient introduites dans le premier compartiment avec les moyens de séparation obturés, les matières dangereuses passant du premier compartiment dans le second compartiment à travers les moyens de séparation avec l'orifice d'entrée et l'orifice de sortie obturés, et les matières dangereuses passant du second compartiment dans la chambre à travers l'orifice de sortie avec les moyens de séparation obturés.

13. Appareil suivant la revendication 12, caractérisé en ce qu'il comporte des moyens, à l'intérieur du second compartiment, crever les récipients contenant les matières dangereuses pour en faire sortir les matières dangereuses.

14. Appareil suivant la revendication 12 ou 13, caractérisé en ce qu'il comporte des moyens de conduit communiquant entre le second compartiment et la chambre pour évacuer les matières dangereuses liquides du second compartiment et pour introduire les matières dangereuses liquides dans la chambre, avec un débit contrôlé.

15. Appareil suivant la revendication 14, caractérisé en ce que les moyens de conduit comprennent des moyens de vanne pour régler le débit des matières dangereuses liquides depuis le second compartiment vers la chambre.

16. Appareil suivant l'une ou l'autre des revendications 12 à 15, caractérisé en ce qu'il comprend des moyens de transporteur à vis pour déplacer les matières dangereuses depuis le second compartiment jusque dans la chambre.

17. Appareil suivant l'une ou l'autre des revendications 1 à 11, caractérisé en ce que les moyens d'entrée comprennent un passage obturable de façon étanche comportant un orifice d'entrée obturable donnant accès à l'extérieur de la chambre et un orifice de sortie obturable assurant une communication vers l'intérieur de la chambre, et des moyens de perforation situés à l'intérieur du passage pour crever les récipients contenant des matières dangereuses.

18. Appareil suivant la revendication 17, caractérisé en ce qu'il comprend des moyens de conduit communiquant entre le passage obturable de façon étanche et la chambre pour évacuer les matières dangereuses liquides hors du passage et introduire les matières dangereuses liquides dans la chambre.

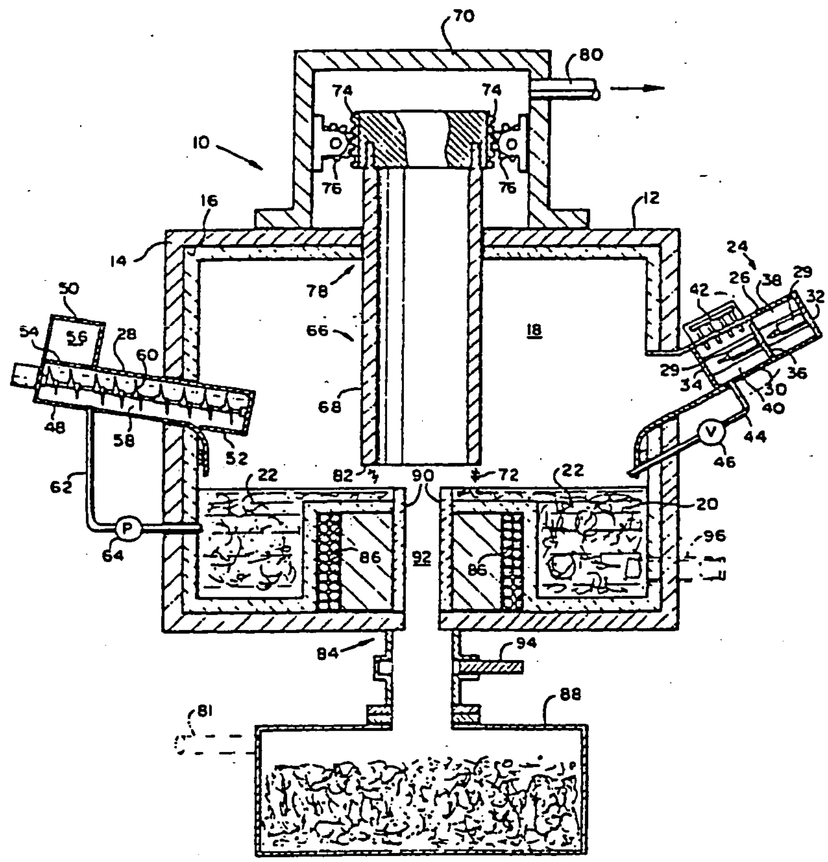
19. Appareil suivant la revendication 18, caractérisé en ce que les moyens de conduit comprennent des moyens de vanne pour régler le débit des matières dangereuses liquides depuis le passage jusque dans la chambre.

20. Appareil suivant l'une ou l'autre des revendications 17 à 19, caractérisé en ce qu'il comprend des moyens de transporteur à vis disposés à l'intérieur dudit passage pour déplacer les matières dangereuses à travers ledit passage jusque dans la chambre.

21. Procédé pour la décomposition de matières dangereuses, caractérisé en ce qu'il est mis en oeuvre dans un appareil suivant l'une ou l'autre

des revendications 1 à 20.

22. Procédé suivant la revendication 21, caractérisé en ce que les matières dangereuses sont du polychlorobiphényle ou des matières contenant des polychlorobiphényles.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48
58
52
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V
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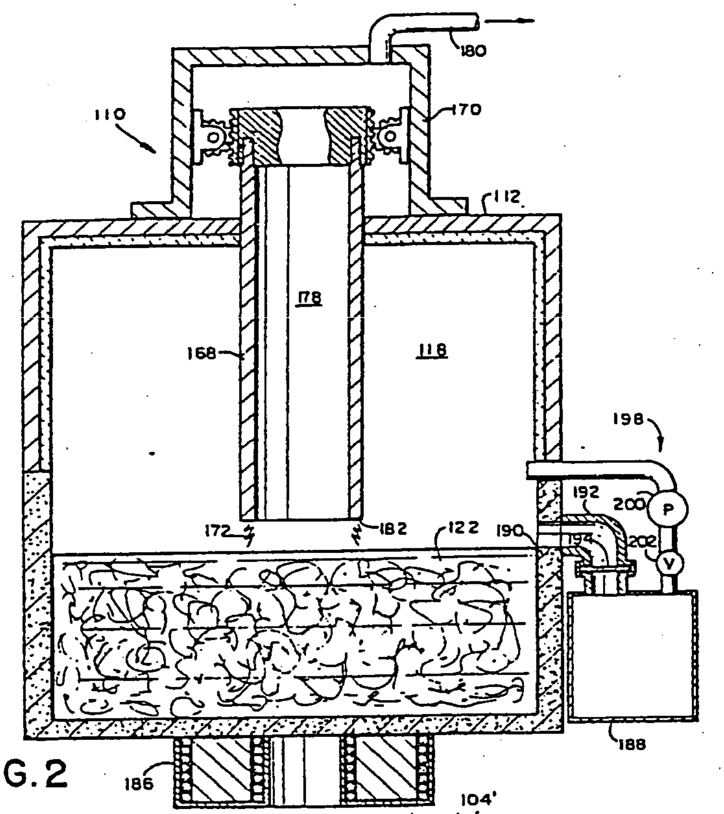
FIG. I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P
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190
194
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V
188
186

FIG.2

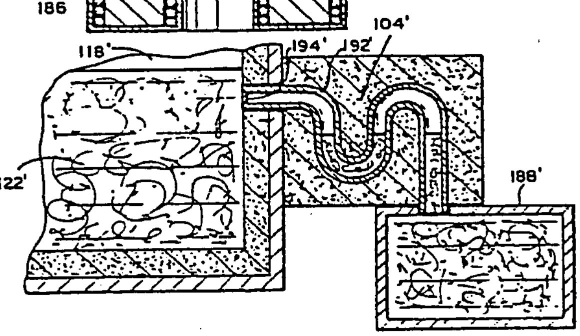
118'
194'
192'
104'
122'
188'

FIG.3

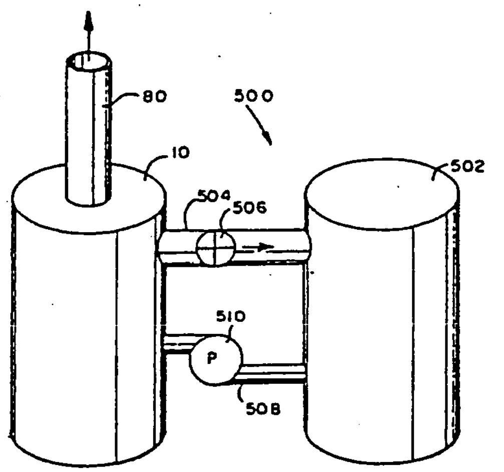

FIG. 5

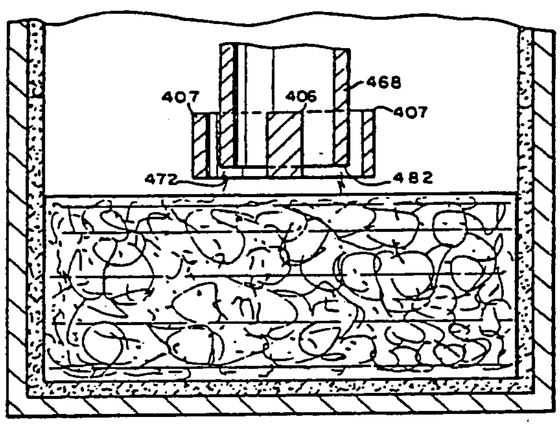

FIG. 4